MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

ECE3266 – DIGITAL AUDIO SIGNAL PROCESSING

(ME)

20th OCT 2016
9:00 AM – 11:00 AM
(2 hours)

INSTRUCTION TO STUDENT

1. This question paper consists of 4 questions on 5 pages.
2. Attempt **ALL** the questions in this paper.
3. The total marks for this paper is 60. The marks allocated for each question is given. The marks are allocated based on the learning outcome of the subject and are therefore not evenly distributed.
4. Please write all your answers in the answer booklet provided. Clearly number your answers.

Question 1

(a) In the context of sound movement, explain the terms: *compression* and *rarefaction*.

[2 marks]

(b) What is a complex waveform? If a waveform is periodic, describe the characteristics of the resulting spectrum. Give ONE (1) example of a periodic sound.

[3 marks]

(c) Figure 1 shows an anatomy of a human ear. Identify **X** and describe its main purpose and functionality.

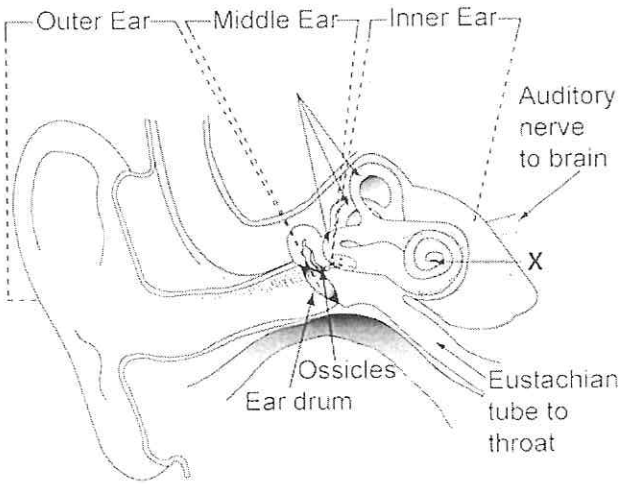

Figure 1

[5 marks]

(d) When 84-year old Ms Hamidah called her grandson at home, his friend picked up the phone and initially assumed it was a man calling.

(i) What is psychoacoustics?

[2 marks]

(ii) Explain the scenario above with regards to psychoacoustics.

[3 marks]

(e) A small concert was held in the local park with trees surrounding the area. Even though Danial had to stand behind a tree quite far from the stage, he could still hear the music quite clearly. Sabrina, who was standing inside a brick shed nearby can also hear the music clearly, but only if she stood by the door.

Continued...

(i) Draw a diagram to describe the above scenario.

[2 marks]

(ii) Explain the behaviour of the sound as it encounters obstacles in its path.

[4 marks]

Question 2

(a) Name FOUR (4) articulators involved in the speech production mechanism.

[2 marks]

(b) Explain the difference between voiced and unvoiced sounds. Give ONE (1) example of a phoneme for each state.

[3 marks]

(c) One way to analyse speech is to study the spectrogram. Siti Nurhaliza wanted to look at the formant changes in her voice as she sang her songs.

(i) Which type of spectrogram should she use? Justify your answer.

[3 marks]

(ii) Explain how to compute the spectrogram you stated in Question 2(c)(i).

[2 marks]

(d) The acoustic theory of speech production models the human vocal tract as a combination of tubes with different sized cross sections. State FOUR (4) other aspects that must be considered for the model.

[4 marks]

(e) Figure 2 shows the waveform of the vowel /i/.

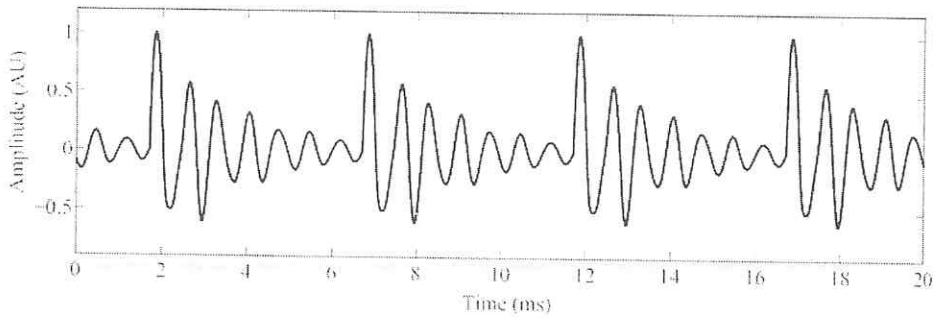

Figure 2

Continued...

(i) Name the THREE (3) types of approaches that we can use to estimate the pitch of the sound.

[3 marks]

(ii) Calculate the fundamental frequency of the sound.

[2 marks]

(iii) Explain the condition of the vocal folds as this sound is produced.

[2 marks]

Question 3

(a) What does MPEG stand for? Why is it so efficient in coding audio-visual information?

[3 marks]

(b) Name the THREE (3) main processes of an analogue to digital conversion.

[3 marks]

(c) Aishah's room has a 3 m high ceiling, and the floor size is 6 m wide and 8 m long. The floor is carpeted and the ceiling is made of acoustic panelling. Since she is a princess, 40% of the walls are glass and the rest are marble.

(i) Determine the approximate reverberation time, RT60, of the room at 2 kHz, ignoring air absorption.

[3 marks]

(ii) The four machines that were used to build Aisha's room produced a combined sound level of 70 dB. What is the average sound level of one machine?

[3 marks]

Question 4

(a) The Youtube video on the conspiracy theory was clearly read by an automatic speech synthesizer. The quality of each word was very clear and sounded human but the intonation, speaking rate and continuity from word to word was—to your ears—very monotonous and unnatural. In your opinion, what type of speech synthesiser was used? Why?

[2 marks]

(b) Give FOUR (4) reasons why developing an Automatic Speech Recognition system can be very challenging.

[4 marks]

End of Questions

Appendix A

Effective Absorption Coefficients of Common Building Materials

Material	Frequency in Hz		
	125	500	2000
Acoustic paneling	0.16	0.50	0.80
Acoustic plaster	0.30	0.50	0.55
Brick wall, unpainted	0.02	0.03	0.05
Draperies			
Light	0.04	0.11	0.30
Heavy	0.10	0.50	0.82
Felt	0.13	0.56	0.65
Floor/Walls			
Concrete	0.01	0.02	0.02
Wood	0.06	0.06	0.06
Carpeted	0.11	0.37	0.27
Glass	0.04	0.05	0.05
Marble or glazed tile	0.01	0.01	0.02
Plaster	0.04	0.05	0.05
Rock wool	0.35	0.63	0.83
Wood paneling, pine	0.10	0.10	0.08